

## PATENT SPECIFICATION

410,009



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## COMPLETE SPECIFICATION.

### Improvements in an Apparatus for the Introduction of Medicaments into the Human or Animal Body by Means of Iontophoresis.

I, DESIDER DEUTSCH, of Hungarian nationality, of Vilmos császár út 15A, Budapest, VI, Hungary, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

My invention relates to an apparatus for the introduction of medicaments into the human or animal body by means of iontophoresis.

The introduction of medicaments into the human or animal body by means of iontophoresis, with the aid of an electric current, in which operation the material (for instance a bunch of cotton or a piece of filtering paper) containing the medicaments is placed between the positive electrode and the human body, whilst the negative electrode is placed on the human body so as to be in immediate contact with its surface and the medicament is carried into the body by the current thus flowing through the body, has been known for a long time. This treatment has proved most effective, particularly in the case of gouty complaints treated by means of Histamin, but it is also most suitable for the introduction of medicaments of a different nature (quinine, caffeine, adrenaline etc.). Further an improvement of this procedure has already become known, by which the positive electrode is united with the material containing the medicament in such a manner that the said material for instance a piece of filtering paper, has, after having been previously impregnated with the necessary quantity of medicament, been coated on one of its sides by means of spraying or by galvanic deposition, with a layer of metal serving as an electrode.

It is a drawback of the original as well as of the last-named improved procedure, however, that a special low-tension source of current is required for feeding the electrode and therefore the length of time of a single treatment can only be short, because the patient, who in most cases is not laid up in bed but is following his usual daily occupation, cannot remain

sitting or lying for many hours near the source of electric current.

Apart herefrom in the procedure employed up to now, there always exists the danger that in case of incorrect regulation of the current intensity or in case of direct contact of the electrode with the human body the skin of the patient may be exposed to burns.

The purpose of the invention is to avoid the drawbacks mentioned above, this purpose being achieved by forming, out of the electrodes and the material containing the medicament, a galvanic cell which itself produces the current necessary for carrying out the iontophoresis. By means of this apparatus, the dimensions and weight of which do not exceed the dimensions and weight possessed in the known types of apparatus by the electrodes and the material containing the medicament without the source of current, it became possible to employ iontophoresis without interfering with the daily work of the patient, being thus possible to introduce the medicament into the body in small quantities, for instance during a time of 24 hours, whereby much better results can be obtained than by the treatment during a short length of time employed up to now. In addition hereto, the danger of burning the patient's skin is here excluded, as the maximum tension of the galvanic cell composed of the electrodes and of the material containing the medicament is about 1 volt and this low tension cannot cause any harm under any circumstance.

There have been known apparatus for the transmission of medicaments into the human body which consisted of blocks of absorbent material adapted to be charged with the medicament, in combination with dry cells supplying the necessary current. However these cylindrical cells made these apparatus very thick and unhandy so that they could not be applied to the body of the patient without disturbing him in his normal occupation.

On the other hand, there have been known so called galvanic boot soles consisting of flat electrodes with an intermediate layer of absorbent material,

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which, when impregnated with the perspiration of the foot, acted as a galvanic cell. However, here the absorbent material was not impregnated with an electrolyte and current was only produced under the effect of the perspiration of the body, moreover, these apparatus were not adapted for the introduction of medicaments into the human body, but only for producing a gentle electric current through the feet.

A few embodiments of the invention, shown by way of example are illustrated in the annexed drawings.

In the embodiment shown in cross section on Fig. 1 the galvanic cell consists of the zinc anode 1, of the carbon cathode 2 and of the material 3 (for instance a piece of filtering paper, gauze or the like) intended to contain the medicament, the said material being arranged between the two electrodes referred to. The circuit is closed by the layer 4 impregnated with a substance possessing electric conductivity (a solution of common salt or other electrolyte), the said layer being insulated from the material 3. For the sake of simplicity, the layers 3 and 4 may consist of the same material, in which case insulation may be ensured by impregnating these layers of material at their point 5 with rubber solution or paraffin. In case of layer 4 also, it is by means of impregnating it with the electrolyte, that electrical conductivity has been imparted, provision must be made for preventing any considerable tension of opposite direction to that of the tension of the galvanic cell being set up between this layer and the anode, because if that were the case, no current would result, for this reason the connection between layer 4 and the anode is, in order to prevent any direct contact between the layer 4 and the anode, effected by means of an additional electrode 6, consisting of some material possessing a negative potential relatively to the substance of the anode, for instance of copper.

The carbon electrode is preferably applied on layer 3 in the form of pulverized graphite, and the pulverized graphite is mixed with manganese peroxide in order that, by employing an ammonium chloride electrolyte, a complete Leclanché cell should thus be obtained.

The layers 3 and 4 are, before setting the apparatus to work, impregnated with a mixture of the electrolyte and of the medicament,—which latter may, for instance, be Histamin,—and are then placed on the human body, so as to make their non-metallic side touch the body.

The human body creates a connection between the carbon electrode and the layer 4, in consequence whereof a current is generated and Histamin ions are, together with the other ions, migrating from the carbon electrode into the human body.

By way of electrolyte, a hygroscopic salt, for instance magnesium chloride or calcium chloride, is preferably employed in order to ensure that the layers 3 and 4 should hereby permanently remain wet and electrically conductive.

In the embodiment illustrated on fig. 2 the human body is connected into the internal circuit of the galvanic cell. In this arrangement it is again a zinc electrode 7 that is employed by way of anode, and a carbon electrode 8 by way of cathode, but here these electrodes are in direct mutual contact and the current flows from the anode through the layer 9 impregnated with the electrolyte and with the medicament into the human body and from the latter through the layer 10 to the cathode. Instead of carbon also tin may be used as material of the cathode and the electrodes can be formed by spraying zinc and tin on the layers 9 and 10, respectively. Instead of spraying, the electrodes can also be formed by galvanic deposition of zinc and tin on the layers 9 and 10 or by metal foils cemented to said layers.

In this arrangement the layers 9 and 10 can by means of impregnating them with an adhesive substance, for instance with rubber solution, be made to constitute a plaster so that the whole apparatus may be applied on the human body in the manner of a plaster.

In order to diminish the external resistance, i.e. the resistance of the direct connection between the anode and the cathode, the anode may also be extended so as to cover the whole area of the cathode, as shown on fig. 3.

In the embodiment illustrated in plan view on fig. 4, the area serving for the introduction of the medicament into the human body has been made much larger than the electrodes, so as to enable the sick limb, for instance the thigh to be thus entirely swathed with the layer containing the medicament. The zinc anode 11 and the copper cathode 12 are here again in direct mutual connection and the anode as well as the cathode are each connected with a tape of paper or of gauze 13, 14. The tape 13 is impregnated with the electrolyte and with the medicament, whilst the tape 14 is impregnated only with the electrolyte or with some other electrically conductive substance, following which the whole

swaddling wrapper is placed on the sick limb and as soon as this has been done, iontophoresis at once starts.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1.) Apparatus for the introduction of medicaments into the human or animal body by means of iontophoresis, characterized by a galvanic cell comprising two electrodes made of materials possessing different electrical potentials and by a layer of material impregnated with the medicament and with an electrolyte, in direct contact with the anode.

2.) An embodiment of the apparatus claimed in claim 1 characterized in that the two electrodes are in direct mutual electrically conductive connection so that it is the internal circuit of the galvanic cell which is open and adapted to be closed by the human body to be medically treated.

3.) An embodiment of the apparatus claimed in claims 1 and 2 characterized in that one of the electrodes covers the other electrode over the whole extent of the latter.

4.) An embodiment of the apparatus claimed in claims 1 to 3, characterized in that the electrically conductive connection between the human body and the cathode likewise is effected by means of a layer of material impregnated with an electrically conductive substance, the said layer of material being connected with the cathode and insulated from the layer of material belonging to the anode.

5.) An embodiment of the apparatus claimed in claims 1—5, characterized in that both electrodes are fitted with a layer of material capable of being impregnated, shared by them in common, the part belonging to the anode of the said layer of material being insulated from that part of the said layer of material which belongs to the cathode, by means of impregnation with an insulating substance.

6.) An embodiment of the apparatus claimed in claims 1—6, characterized in that the layers of material to be impregnated with the medicament and/or with an electrolyte form tapes arranged at both sides of the electrodes being in direct mutual connection.

7.) An embodiment of the apparatus claimed in claim 1, characterized in that the layer of material impregnated with the electrolyte and with the medicament is arranged between the two electrodes which are not in mutual contact and it is the external circuit of the galvanic cell thus formed which is to be closed by the

human body.

8.) An embodiment of the apparatus claimed in claims 1 and 8 characterized in that the connection between the human body and the cathode is effected in a direct manner whilst the connection between the human body and the anode is effected by means of a layer of material impregnated with an electrically conductive substance, the said layer of material being insulated from the layer of material containing the electrolyte.

9.) An embodiment of the apparatus claimed in claims 1 and 9, characterized in that the layer of material serving for closing the external circuit is likewise impregnated with electrolyte and is not connected with the anode in a direct manner but through an intermediate additional electrode consisting of a material possessing a negative potential relatively to the anode.

10.) An embodiment of the apparatus claimed in claims 1—10, characterized in that the anode consists of zinc and the cathode of carbon.

11.) An embodiment of the apparatus claimed in claims 1 and 10 characterized in that the third electrode, which is in connection with the anode, consists of copper.

12.) An embodiment of the apparatus claimed in claims 1—12, characterized in that the layers of material to be impregnated with the electrolyte, or respectively with the electrolyte and the medicament, consist of filtering paper.

13.) An embodiment of the apparatus claimed in claims 1—12, characterized in that the layers of material to be impregnated with the electrolyte, or respectively with the electrolyte and the medicament, consist of textile fabrics.

14.) An embodiment of the apparatus claimed in claims 1—14, characterized in that the electrolyte consists of a solution of ammonium chloride.

15.) An embodiment of the apparatus claimed in claims 1—14 characterized in that the electrolyte consists of a solution of magnesium chloride.

16.) An embodiment of the apparatus claimed in claims 1—14 characterized in that the electrolyte consists of a solution of calcium chloride.

17.) An embodiment of the apparatus claimed in claims 1—17, characterized in that the electrodes consist of metal foils cemented on the layer of material to be impregnated with the electrolyte.

18.) An embodiment of the apparatus claimed in claims 1—17, characterized in that the electrodes consist of a layer of metal sprayed on the layer of material to be impregnated with the electrolyte.

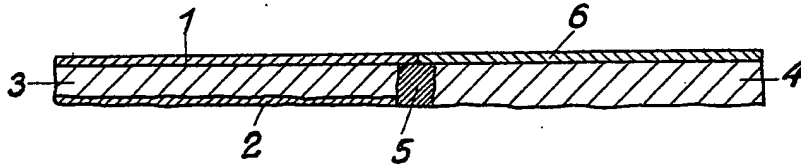
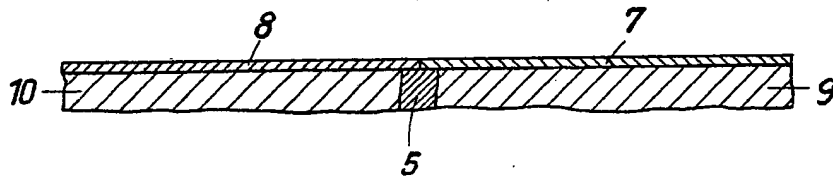
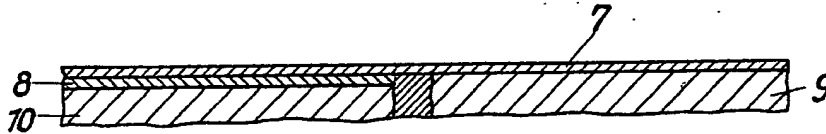
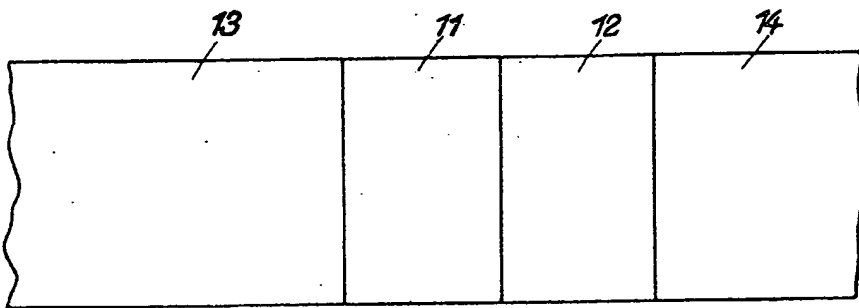
19.) An embodiment of the apparatus claimed in claims 1—17, characterized in that the cathode consists of pulverized graphite, smeared on the layer of material to be impregnated with the electrolyte.

20.) An embodiment of the apparatus claimed in claims 1—17 characterized in that the cathode consists of a mixture of manganese peroxide and pulverized graphite, smeared on the layer of material to be impregnated with the electrolyte.

21.) An embodiment of the apparatus claimed in claims 1—17, characterized in that the layer of material to be impregnated with the electrolyte is made to constitute a plaster by impregnating it with an adhesive substance.

Dated this 16th day of October, 1933.

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*Fig. 1**Fig. 2**Fig. 3**Fig. 4*

[This Drawing is a reproduction of the Original on a reduced scale.]

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